

V. REMARKS

Claims 1-9 are rejected under 35 U.S.C. 102(b) as unpatentable over Ayata et al. (U.S. Patent No. 4,463,359). The rejection is respectively traversed.

Claim 1 is directed to a method for driving a recording head having a plurality of heating elements as driving elements for ejecting ink droplets from a plurality of nozzles. Claim 1 recites a time-division driving step that drives the plurality of heating elements into a plurality of blocks with each block consisting of a predetermined number of spatially arranged heating elements of the plurality of heating elements corresponding to the plurality of nozzles. Claim 1 further recites that each set of the heating elements simultaneously driven over the respective blocks is sequentially driven in a time-divisional manner in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements

Ayata discloses time-division drive. However, in Ayata, time-division drive for each block is shifted between adjacent blocks as shown in Figure 24 in which PP1, PP9, PP17 and PP25 are driven, PP2, PP10, PP18 and PP26 are driven next, which are nozzles adjacent to the previous nozzles in the respective blocks. On the contrary, the claimed invention discloses that in time-division drive carried out for each block, not only the adjacent nozzles in the respective blocks are driven next but also the driving order is different. In the specification on page 20, lines 2-5, it states "in order to avoid the influence of cross-talk due to the driving of the adjacent heating elements, the driving order may be changed so that the distant heating elements are driven next." It is respectfully submitted that this feature is not disclosed in Ayata.

It is respectfully submitted that the rejection is improper because the applied art fails to teach each element of claim 1. Specifically, the applied art fails to teach that each set of the heating elements simultaneously driven over the respective blocks is sequentially driven in a time-divisional manner in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements. Thus, it is respectfully submitted that claim 1 is allowable over the applied art.

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Claim 4 is directed to a recording head having a plurality of heating elements as driving elements for ejecting ink droplets from a plurality of nozzles, the plurality of heating elements being arranged in a direction substantially perpendicular to the direction of carrying a carried recording medium. Claim 4 recites that the recording head includes time-division driving means for dividing the plurality of heating elements into a plurality of blocks with each block consisting of a predetermined number of spatially and sequentially arranged heating elements of the plurality of heating elements corresponding to the plurality of nozzles. Claim 4 recite that respective ones of the heating elements and the corresponding nozzles in each block are positioned similarly to form respective positional sets and sequentially drive each set of heating elements simultaneously driven over the respective blocks, in a time-divisional manner, in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements.

It is respectfully submitted that the rejection is improper because the applied art fails to teach each element of claim 4. Specifically, the applied art fails to teach that that respective ones of the heating elements and the corresponding nozzles in each block are positioned similarly to form respective positional sets and sequentially drive each set of heating elements simultaneously driven over the respective blocks, in a time-divisional manner, in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements. As a result, it is respectfully submitted that claim 4 is allowable over the applied art.

Claims 2 and 3 depend from claim 1 and include all of the features of claim 1. Claims 5 and 6 depend from claim 4 and include all of the features of claim 4. Thus, it is respectfully submitted that the dependent claims are allowable at least for the reasons the independent claims are allowable as well as for the features they recite.

Withdrawal of the rejection is respectfully requested.

Claims 7-9 are rejected under 35 U.S.C. 103(a) as unpatentable over Ayata in view of Hackleman et al. (U.S. Patent No. 5,600,354). The rejection is respectfully traversed.

Hackelman teaches a page-wide ink jet printhead containing a reservoir of ink that includes a page-wide printhead substrate, a plurality of groups of heater elements, a plurality of printhead circuit elements and a device for serially interconnecting the printhead circuit elements. The page-wide printhead substrate has a first dimension defining a printhead width. The printhead has a plurality of groups of orifices formed therein and to incrementally encompass the width of the printhead. The plurality of groups of heater elements are mounted on the substrate. Each heater element vaporizes ink disposed proximate a corresponding orifice to eject therefrom. The plurality of printhead circuit elements are mounted on the substrate. Each circuit element is associated with a group of heater elements for selectively energizing a heater element from the group. The interconnecting device provides an address and an associated command to a printhead circuit element. The address specifies a printhead circuit element that the command is address to. The command specifies which of the heater elements in the address printhead circuit element are to be actuated.

Claim 7 is directed to an ink jet printer having a recording head having a plurality of heating elements as driving elements for ejecting ink droplets from a plurality of nozzles. Claim 7 recites time-division driving means for dividing the plurality of heating elements into a plurality of blocks with each block consisting of a predetermined number of spatially arranged heating elements of the plurality of heating elements corresponding to the plurality of nozzles. Claim 7 further recites that each set of heating elements simultaneously driven over the respective blocks is sequentially driven in a time-divisional manner in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements.

Ayata discloses an example of a zigzag array of ink jet blocks (i.e. head chips) as shown in Figure 18 but the ink jet blocks do not overlap each other.

It is respectfully submitted that the rejection is improper because the applied art fails to teach each element of claim 7. Specifically, the applied art fails to teach that each set of heating elements simultaneously driven over the respective blocks is sequentially driven in a time-divisional manner in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders

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being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements. Thus, it is respectfully submitted that claim 7 is allowable over the applied art.

Claims 8 and 9 depend from claim 7 and include all of the features of claim 7. Thus, it is respectfully submitted that the dependent claims are allowable at least for the reasons the independent claims are allowable as well as for the features they recite.

Withdrawal of the rejection is respectfully requested.

Claims 10-15, 18-24, 27-33 and 36 are rejected under 35 U.S.C. 103(a) as unpatentable over Ayata in view of Sekiya (U.S. Patent No. 5,877,786). The rejection is respectfully traversed.

Claim 10 is directed to a method for driving a recording head having a plurality of heating elements as driving elements for ejecting ink droplets from a plurality of nozzles with the plurality of heating elements being arranged in a direction substantially perpendicular to the direction of carrying a carried recording medium.

Claim 10 recites that the method includes:

a drive signal generating step of generating an element drive signal made of necessary data for forming one dot so as to modulate the diameter of a dot by the number of ink droplets, using one or a plurality of ink droplets for forming one dot; and

a time-division driving step of dividing the plurality of heating elements into a plurality of blocks, each block consisting of a predetermined number of spatially arranged heating elements of the plurality of heating elements corresponding to the plurality of nozzles, and sequentially driving each set of heating elements simultaneously driven over the respective blocks, in a time-divisional manner in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements method for driving a recording head having a plurality of heating elements as driving elements for ejecting ink droplets from a plurality of nozzles.

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Sekiya discloses the concept of pulse number modulation control and also discloses that when T represents the time for maximum bubbles to be formed from the application of a pulse, the next pulse application should be 4T after the previous pulse application in order to stabilize ink ejection (see column 11, line 57 to column 12, line 2).

It is respectfully submitted that none of the applied art, alone or in combination, teaches or suggests the features of claim 10. Specifically, none of the applied art teaches or suggests a time-division driving step of dividing the plurality of heating elements into a plurality of blocks, each block consisting of a predetermined number of spatially arranged heating elements of the plurality of heating elements corresponding to the plurality of nozzles, and sequentially driving each set of heating elements simultaneously driven over the respective blocks, in a time-divisional manner in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements. Thus, one of ordinary skill in the art would not be motivated to combine the features of the applied art because such combination would not result in the claimed invention. Therefore, it is respectfully submitted that claim 10 is allowable over the applied art.

Claim 19 is directed to recording head having a plurality of heating elements as driving elements for ejecting ink droplets from a plurality of nozzles with the plurality of heating elements being arranged in a direction substantially perpendicular to the direction of carrying a carried recording medium. Claim 19 recites that the recording head includes drive signal generating means for generating an element drive signal made of necessary data for forming one dot so as to modulate the diameter of a dot by the number of ink droplets, using one or a plurality of ink droplets for forming one dot and time-division driving means for dividing the plurality of heating elements into a plurality of blocks. Claim 19 recites that each block consists of a predetermined number of spatially arranged heating elements of the plurality of heating elements corresponding to the plurality of nozzles, and sequentially driving each set of heating elements simultaneously driven over the respective blocks, in a time-divisional manner of in a selected one of a variety of different driving orders, the selected one of the variety of different driving orders

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being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements.

Sekiya describes a technique for matching the center position of a pixel and the center position of an ink drop as described in column 16, lines 35-41. However, Sekiya only discloses a technique in which the pulse application timing is delayed when the pulse number is small.

It is respectfully submitted that none of the applied art, alone or in combination, teaches or suggests the features of claim 19. In particular, none of the applied art teaches or suggests a predetermined number of spatially arranged heating elements of a plurality of heating elements corresponding to a plurality of nozzles, and sequentially driving each set of heating elements simultaneously driven over respective blocks, in a time-divisional manner in a selected one of a variety of different driving orders with the selected one of the variety of different driving orders being a driving order in which none of the next-driven heating elements is adjacent to any of the immediately previously-driven heating elements. Thus, one of ordinary skill in the art would not be motivated to combine the teachings of the applied art because such combination would not result in the claimed invention. Therefore, claim 19 is allowable over the applied art.

Claim 28 is directed to an ink jet printer having a recording head having a plurality of heating elements as driving elements for ejecting ink droplets from a plurality of nozzles. Claim 28 recites correcting means for correcting unevenness of print density by controlling pulse number modulation.

It is respectfully submitted that none of the applied art alone or in combination, teaches or suggests the features of claim 28. Specifically, none of the applied art teaches or suggests correcting means for correcting unevenness of print density by controlling pulse number modulation. As a result, one of ordinary skill in the art would not be motivated to combine the features of the applied art because such combination would not result in the claimed invention. Therefore, claim 28 is allowable over the applied art.

Claims 11-15 and 18 depend from claim 10 and include all of the features of claim 10. Claims 20-24 and 27 depend from claim 19 and include all of the features of claim 19. Claims 29-33 and 36 depend from claim 28 and include all of the

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features of claim 28. Thus, the dependent claims are allowable at least for the reasons the independent claims are allowable as well as for the features they recite.

For instance, claims 13 and 14 include features not shown in the applied art. Claim 13 recites that, at a drive signal generating step, the order of the pulses to be objects of comparison with the record data is determined so that a dot to be formed on the recording medium is equivalent to a dot formed by distributing the ink droplets in the direction of carrying the recording medium from a lattice point as the center, which is the position on the recording medium in forming one dot with one ink droplet.

Claim 14 recites that, at the drive signal generating step, in the case of forming one dot with the ink droplets of even ordinal numbers, the order of the pulses to be objects of comparison with the record data is determined so that the resulting dot is equivalent to a dot formed by distributing the ink droplets of odd ordinal numbers and the droplets of the even ordinal numbers in the direction of carrying the recording medium symmetrically about the lattice point as the center.

In the claimed invention, pulse number modulation control is carried out in consideration of whether the pulse number is even or odd as discussed in the specification commencing on page 46, line 2 and in Figs. 24-32. The features of claims 13 and 14 are not disclosed in Sekiya. In Sekiya, only the application timing is delayed when the pulse number is small. In Sekiya, whether the pulse number is even or odd is not a problem as described in column 17, lines 21-22. In the claimed invention, whether the pulse number is even or odd is problematic.

As discussed above, it is respectfully submitted that claims 13 and 14 are allowable over the applied art for these additional reasons.

Withdrawal of the rejection is respectfully requested.

In view of the foregoing, reconsideration of the application and allowance of the pending claims are respectfully requested. Should the Examiner believe anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' representative at the telephone number listed below.

Should additional fees be necessary in connection with the filing of this paper or if a Petition for Extension of Time is required for timely acceptance of the same, the Commissioner is hereby authorized to charge Deposit Account No. 18-0013 for

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any such fees and Applicant(s) hereby petition for such extension of time.

Respectfully submitted,

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By: \_\_\_\_\_

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